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SUBJECT: SOLAR CELL MANUFACTURING - NEW ENGINE FOR  
TAIWAN'S ECONOMY?

¶1. (U) Summary: Taiwan's solar cell manufacturing industry will triple in capacity this year after nearly doubling in 2006. Although manufacturing of solar cells is booming, Taiwan is less competitive in other segments of the industry's supply chain. Taiwan's solar cell makers face two major constraints to growth: a shortage of polysilicon supply and demand that is dependent on government subsidies. Nevertheless, the outlook for the industry is good, and some insiders believe it could be an important engine for Taiwan's future economic growth. End summary.

#### Tripling Capacity in 2007

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¶2. (SBU) Taiwan's solar cell manufacturing industry has grown at a remarkable pace. According to the Industrial Technology Research Institute (ITRI), the total manufacturing capacity of Taiwan's solar cell makers as measured by the total megawatt (MW) capacity of cells produced was just 128.4 MW in 2005. It increased to 237.1 MW in 2006 and is projected to reach 743.6 MW for ¶2007. ITRI predicts the industry's capacity will top 1,250 MW in 2008. Lan Chung-wen, the General Director of ITRI's Photovoltaics Technology Center told us the value of Taiwan's solar cell output was NT\$23 billion (US\$700 million) in 2006 but was projected to reach NT\$80 billion (US\$2.4 billion) by 2010.

¶3. (SBU) Motech is Taiwan's largest solar cell manufacturer. It was founded in 1981 and manufactures various kinds of power supply equipment. It didn't start making solar cells until 2000. By 2005, its capacity had reached 60 MW and has grown to 280 MW this year. Jacy Chen, the Special Assistant to Motech's Chairman, told us the firm projects its capacity will reach 400 MW in 2008 and 1000 MW (or 1 gigawatt - GW) in 2012. He said the firm's revenue from solar cells had grown by approximately 100 percent each year since 2004. During a January visit to Motech's manufacturing facility in the Southern Taiwan Science Park in Tainan, we were shown state-of-the-art facilities relying largely on automated equipment for the manufacturing process. Today 95 percent of Motech's revenue comes from solar cell sales. It is now the world's seventh largest solar cell

manufacturer. ITRI's Lan predicted it could become the fifth largest by the end of this year.

¶4. (SBU) DelSolar is another fast-growing Taiwan solar cell manufacturer. It is a unit of Delta electronics, another Taiwan power supply equipment maker. DelSolar was founded less than three years ago starting with a team of approximately 15 photovoltaic researchers hired from ITRI. Its capacity has doubled each year starting from 25 MW in 2005 and projected to reach 100 MW this year. CEO R.C. Liang told us that the firm had total revenue of US\$87 million in 2006.

#### Taiwan's Midstream Advantage

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¶5. (SBU) Taiwan's strength in the solar energy industry lies in solar cell manufacturing -- the midstream segment of photovoltaic manufacturing. Taiwan currently has 12 solar cell makers, like Motech and DelSolar. Taiwan firms are competitive in this market because the technology has some similarities with semiconductor and thin-film-transistor liquid crystal display (TFT-LCD) manufacturing. It is technology intensive but with low barriers to entry. According to Lan, a firm can set up a production line with an annual capacity of 30 MW for just US\$10 million.

¶6. (SBU) Taiwan is less competitive in the upstream and downstream segments of the manufacturing process. Solar cell makers use polysilicon wafers to manufacture the cells. Taiwan has three wafer manufacturers and no producers of raw polysilicon. Downstream, solar cell makers sell their output to solar cell module assemblers that turn the basic cell into the final product. Taiwan

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has only 4 module assemblers. ITRI's Lan explained that that module makers must be certified by international laboratories, most of which are located in Europe and North America. Only one of Taiwan's module assemblers has international certification. In addition, the module manufacturing process is more labor intensive. Because of these factors, Taiwan exports approximately 90 percent of its solar cells to module makers in China, Europe and elsewhere.

#### Constraints to Growth - Supply...

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¶7. (SBU) Growth of the solar cell manufacturing industry faces two major constraints. On the supply side, the industry is currently facing a global polysilicon shortage. DelSolar's Liang noted that polysilicon prices have risen six-fold in the last few years since the shortage began. He said that polysilicon currently accounts for nearly 40 percent of DelSolar's production costs. Motech's Chen explained that polysilicon manufacturers expanded rapidly during the dot-com boom of the late 1990s, causing excess supply prior to 2005. In response, the polysilicon producers stopped expansion. Because it takes some time to get a new polysilicon production line up and running, they have not yet been able to address the shortage that emerged in 2006 with rapid growth in the solar cell industry. ITRI's Lan pointed out that the polysilicon industry is controlled by an oligopoly of six firms based in Germany, Japan, and the United States. He surmised that with the shortage driving up prices they have been slow to expand production. Senior Vice President Charlie Han of NexPower, another solar cell maker, estimated that polysilicon producers currently have profit margins of nearly 70 percent.

¶8. (SBU) Liang speculated that with output expansion underway, the polysilicon shortage should be less severe

within two to three years. Lan also cited reports that the shortage would begin to disappear in 2009. However, he expressed skepticism that the situation would improve that quickly. In the meantime, Taiwan firms have taken other steps to ensure a steady supply. DelSolar and Motech have both signed long-term agreement with polysilicon suppliers. Motech has gone a step further by purchasing a 10 percent stake in AE Polysilicon, a Pennsylvania-based polysilicon producer.

...and Demand

¶9. (SBU) Solar cell makers face another major constraint on the demand side. Electricity generated by solar cells is still much more expensive than power from fossil fuels. According to ITRI, it can cost 10 times the price of retail electricity prices and the market only exists because of government subsidies. Lan highlighted Germany as one of the primary markets thanks to government programs, including 20-year low interest loans. Motech's Chen argued that because subsidies play such an essential role in the market, governments are more inclined to protect domestic producers from imports. This places Taiwan firms at a disadvantage, he said, because Taiwan has no significant subsidy programs and a negligible domestic solar cell market. In the meantime, Motech is addressing this problem by forming partnerships with module makers in subsidized markets.

¶10. (SBU) Lan commented that solar energy costs have fallen by dramatically over the last 20 years and will continue to fall. However, he does not believe they will fall enough in the short to medium term to make solar cells competitive with fossil fuels without subsidies. Relief of the polysilicon shortage will help, but there are limits to how far the technology can be improved. The maximum theoretical conversion rate for the kinds of solar cells currently produced by most Taiwan firms is only about 25 percent. Taiwan's most advanced cells in production have a conversion rate of 17 percent. Taiwan

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firms have only modest expectations of being able to improve the efficiency of their solar cells. Motech hopes to reach a conversion rate of 20 percent in the near future. DelSolar is targeting a conversion rate of 19 percent by 2009.

Comment - The Next Trillion NT\$ Industry?

¶11. (U) In recent months, the solar cell manufacturing industry has attracted a lot of attention from investors in Taiwan. As concerns about global warming grow and oil prices increase, solar energy will become a more attractive alternative. Taiwan manufacturing firms have an impressive track record at bringing down the manufacturing costs for high-tech components. More than one industry executive we spoke with expressed optimism that the solar cell industry could become a key driver for Taiwan's economy, even going as far as saying it could become another NT\$1 Trillion (US\$30 billion) industry like semiconductors and flat-panel displays. The constraints the industry faces are formidable. However, solar cell manufacturing is an industry that bears watching in the months and years ahead.

YOUNG